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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(60) Parent Application or Grant
NOR.WEB DPL LIMITED [/]; (). BROWN, Paul, Anthony [/]; (). SUMMERSCALES, Brian [/]; (). BROWN, Paul, Anthony [/]; (). SUMMERSCALES, Brian [/]; (). HACKNEY, Nigel, J. ; ().

Published

(54) Title: COUPLING APPARATUS AND METHOD

(54) Titre: APPAREIL ET PROCEDE DE COUPLAGE

(57) Abstract

The present invention relates to coupling apparatus for fitting to a conductor or cable. In particular, it refers to high frequency coupling apparatus suitable for telecommunications signals propagated, at least in part, along conventional power distribution cables. Accordingly, in a first aspect, the present invention provides a coupling apparatus suitable for coupling with an electricity cable (2), where the cable includes an electrically insulated conducting member (1), where the coupling apparatus includes cable insulation penetration means (3) for penetrating the electricity cable to provide an electrical connection to the conducting member, the penetration means (3) being electrically connected to a coupling member (5) suitable for connection to a telecommunications signal source or receiver. In this way, a coupling member suitable for connection to a telecommunications signal source or receiver may be electrically connected to the conducting core of a power cable or other type of conductor.

(57) Abrégé

L'invention concerne un appareil de raccordement destiné à être couplé à un conducteur ou un câble et, plus particulièrement, un appareil de raccordement haute fréquence approprié pour des signaux de télécommunication diffusés, au moins partiellement, par des câbles de distribution de puissance. En conséquence, dans un premier aspect, l'invention concerne un appareil de raccordement conçu pour être couplé à un câble électrique (2), qui comporte un élément conducteur isolé électriquement (1). L'appareil de raccordement comporte un dispositif de pénétration d'isolation (3) du câble destiné à pénétrer le câble électrique afin d'établir une connexion électrique avec l'élément conducteur, le dispositif de pénétration (3) étant électriquement connecté à un élément de raccordement (5) conçu pour être connecté à une source ou à un récepteur de signaux de télécommunication. De cette manière, un élément de raccordement conçu pour être connecté à une source ou à un récepteur de signaux de télécommunication peut être électriquement connecté au noyau conducteur d'un câble de puissance ou à un autre type de conducteur.

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Published

With international search report.

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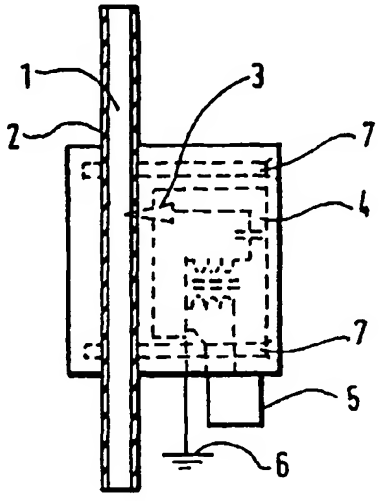
The present invention relates to coupling apparatus for fitting to a conductor or cable. In particular, it refers to high frequency coupling apparatus suitable for telecommunications signals propagated, at least in part, along conventional power distribution cables. Accordingly, in a first aspect, the present invention provides a coupling apparatus suitable for coupling with an electricity cable (2), where the cable includes an electrically insulated conducting member (1), where the coupling apparatus includes cable insulation penetration means (3) for penetrating the electricity cable to provide an electrical connection to the conducting member, the penetration means (3) being electrically connected to a coupling member (5) suitable for connection to a telecommunications signal source or receiver. In this way, a coupling member suitable for connection to a telecommunications signal source or receiver may be electrically connected to the conducting core of a power cable or other type of conductor.



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Description

COUPLING APPARATUS AND METHOD

The present invention relates to coupling apparatus for fitting to a conductor or cable. In particular, it refers to high frequency coupling apparatus suitable for telecommunications signals propagated, at least in part, along conventional power distribution cables.

The transfer of communication signals along electricity distribution and/or transmission networks is a promising development in the telecommunications industry. The communication signals may be transferred even whilst the power cables/conductors are energized.

Various technical aspects of systems whereby telecommunications signals can be conveyed along an electricity distribution and/or transmission network are disclosed in published patent applications of the present applicant. These applications include the following: WO94/09572, WO95/29572, WO95/29537, WO96/07245, WO98/19398, the disclosures of which are incorporated herein by reference.

It is desirable that the coupling of telecommunication signals onto power distribution and/or transmission networks be achieved in a safe, efficient and cost-effective way.

The present invention aims to provide a method and apparatus for effectively coupling communication signals onto and off an existing, possibly energized, mains electricity distribution and/or transmission network.

Accordingly, in a first aspect, the present invention provides a coupling apparatus suitable for coupling with an electricity cable, where the cable includes an electrically insulated conducting member, where the coupling apparatus includes cable insulation penetration means for penetrating the electricity cable to provide an electrical connection to the conducting member, the penetration means being electrically connected to a coupling member suitable for connection to a telecommunications signal source or receiver.

In this way, a coupling member suitable for connection to

a telecommunications signal source or receiver may be electrically connected to the conducting core of a power cable or other type of conductor.

Thus the coupling device could be retro-fitted to an existing power distribution and/or transmission network. To minimize disruption to consumers' power supplies and to avoid time-consuming installation, preferably the coupling device should be adapted to be fitted to, for example, an insulated power cable without disconnecting that power cable from the power source, i.e. while the cable is "energized" or live.

The coupling member is electrically isolated at low frequencies (e.g. 50/60 Hz or possibly up to 100 or 200 Hz) from the insulation penetration means using a low frequency protection means such as a high pass filter, for example a suitable capacitor. Furthermore, the coupling member may be electrically protected from the cable insulation protection means by, for example a fuse and/or transformer, e.g. a balun transformer.

The insulation penetration means is adapted to pierce a sleeve of electrical insulation material around the power cable or conductor and hence come into and establish electrical contact with the electrical current carrying part of the conductor. In this way, the coupling device is suitable for attachment to a power cable or conductor at many different places along the cable or conductor length.

In some instances, it might not be desirable for the electronic components to be attached to the cable at all times. Accordingly, in a second aspect, the present invention provides a coupling device including a clamp and a clamp head. The clamp includes the insulation penetration means and means for fitting the insulation penetration means to the cable. The clamp head includes a coupling member suitable for connection to a telecommunications signal source or receiver. The coupling member is preferably protected by low frequency protection means such as a high pass filter, for example a suitable capacitor. Furthermore, the coupling member may be electrically protected from the cable insulation

penetration means by, for example, a fuse and/or balun transformer.

In a preferred embodiment of the present invention, one end of the primary winding and/or one end of the secondary winding of the transformer is/are electrically bonded to an earth potential. Furthermore, in another preferred embodiment, one end of both the primary and secondary windings of the transformer are electrically bonded to the same earth potential.

In another preferred embodiment of the present invention, the cable insulation means includes a spike. Additionally or alternatively, this spike may be rigid. Additionally or alternatively, the spike may be electrically conducting. Additionally or alternatively, there may be a plurality of spikes, preferably spaced 0.5 - 1.5cm apart, most preferably around 1cm apart.

Preferably, the present invention includes clamping means for urging the penetration means into the cable the clamping means may include a screw operated compression

member.

Preferably, the present invention includes a housing which, in use, fits around the cable.

In another preferred embodiment of the present invention, the coupling apparatus includes a two part housing, the first part containing the coupling member and the second part containing the penetration means wherein the two parts are releasably joined together. Preferably, the clamping means is included in the second part of the housing.

Preferably, the cable insulation penetration means and the coupling member are electrically connected via a conducting spring.

Embodiments of the present invention will now be described with reference to the accompanying drawings in which:-

Figure 1 is a schematic diagram of a coupling device

according to a first embodiment in which the main internal components are illustrated.

Figure 2 is an exploded schematic diagram of a coupling device according to the first embodiment, showing the device in its two main component pieces.

Figure 3 is an exploded schematic diagram of a coupling device according to the first embodiment, corresponding to a section viewed in a plane which is perpendicular to the axis of the cable at the line marked "X-X" in Figure 2.

Figure 4 is a schematic diagram of a coupling device according to a second embodiment in which the main internal components are illustrated.

Figure 5 is an exploded schematic diagram of a coupling device according to the second embodiment, showing the device in its three main component pieces.

Figure 6a is a side view of a coupling device according

to a further embodiment of the present invention;

Figure 6b is an end view of the device of Figure 6a;

Figure 7a is a side view of a further embodiment of a coupling device according to the present invention; and

Figure 7b is an end view of the device of Figure 7a.

Figures 1, 2 and 3 show a coupling device according to the first embodiment of the present invention. The unit consists of two parts 21 and 22, constructed in part using a strong, non-conducting material, which are clamped tightly together using, for example, two screws 7. The device is preferably clamped across an insulated power cable 2. The outline of the unit is preferably shaped to fit an insulated cable 2 between the two parts of the coupling device 21 and 22. For example, the outline of the coupling device is concave, as shown in Figure 3. The insulation penetration means preferably includes a rigid conducting spike 3. This spike protrudes a pre-set distance into the concave outline of

the unit. The insulation 8 is pierced and electrical contact is made between the rigid conducting spike 3 and the metallic power conductor 1 as the clamping screws 7 are tightened.

The rigid conducting spike 3 is electrically connected to a circuit 4, schematically shown in Figure 1. This circuit preferentially includes one or more protection devices such as a fuse and a balun transformer. The circuit further includes a low frequency protection device such as a high pass filter for the high frequency communication signals, for example a suitable capacitor. The circuit is provided with a coupling member such as a communications signal input/output port, typically a coaxial, unbalanced, high frequency, standard BNC connector 5 well known in the art. Preferably, a safety earth is attached via 6 in Figure 1. Additionally or alternatively an isolation capacitor may be included on the "braid" side of the coaxial connector 5 in order to isolate it from the mains electricity supply in the event of a fault.

In this first embodiment, the circuit 4 is entirely contained within the insulating casing of the device. Therefore, during installation of the coupling device, no 'live' conducting elements are exposed, either on the cable or on the device itself.

Figures 4 and 5 illustrate a coupling device according to a second embodiment of the present invention. The device is constructed in part using a strong, non-conducting material and is made up of three main parts 51, 52 and 53. Main parts 51 and 52 are shaped, for example in a concave sense, so that an insulated cable 31 may fit between them in a similar sense to the first embodiment, shown in Figure 3. Parts 51 and 52 may be clamped tightly together using a single screw 40. A rigid conducting spike 34, similar to a spike 3 in the first embodiment, protrudes a pre-set distance into the concave outline of part 52. The insulation 42 is pierced and electrical contact is made between the rigid conducting spike 34 and the metallic power conductor 32 as the clamping screw 40 is tightened.

The rigid conducting spike may be electrically connected to a fuse carrier and link 36 via a conducting spring 35 when the clamp 33, made up using main parts 51 and 52, is attached to a clamp head 37 (or 53) via screws 41. The clamp head contains a circuit 36, preferentially including protection devices such as a fuse and a balun transformer. The circuit further includes a low frequency protection device such as a high pass filter for high frequency communication signals and is similar to the circuit 4 described in outline in the first embodiment of the invention. The circuit 36 is provided with a coupling member such as a communications signal input/output port, typically a coaxial, unbalanced, high frequency, standard BNC connector 38 well known in the art. Preferably, a safety earth is attached via 39.

The second embodiment of the present invention allows the clamp head 53 to be easily removed from the cable clamp 51 and 52 whilst, if desired, leaving the cable clamp 51 and 52 still attached to the cable. The cable clamp may then be covered using a fascia plate. This removes the need to place an insulating sleeve over the puncture hole

in the cable insulation if it is required to remove the coupling device from the cable at some later date.

The embodiment of the invention shown in Figures 6a and 6b consists principally of a first part 60 of the coupling unit and a saddle 61. As will be seen, the saddle 61 sits on top of the coupling unit part 60. The saddle may, for example, be made of steel and may be around 20 x 30 x 3mm in size including a tapped hole for receipt of a screw 62, with for example a 5mm thread.

In use, the unit 60 is placed against an insulated cable 63 to a conductor of which contact is required to be made. Initially, the saddle lies against or adjacent the top of the part 60 as shown in Figure 6a. The contacts (not shown) project against the cable 63.

One or more cable ties 64 (in this embodiment, two ties are used) secure the unit 60 against the cable 63. In this embodiment each of the cable ties 64 is located on a respective side of the screw 62 and also serve to hold the saddle against the unit 60. As will be seen more

clearly in Figure 6b, the eye 65 of each cable tie abuts against a square edge 66 of the saddle 61. By contrast, the edge 67 of the saddle 61 over which the elongate portion of the cable tie 64 lies is rounded so as to relieve the stress on the cable tie. Also optionally provided are locating notches in the saddle 61 (not shown) which serve to locate the elongate portion of the cable ties 64. In some embodiments, the rounded edges mentioned previously may only be provided in the locating notches.

Once the cable ties have been tightened as much as possible by hand in the conventional manner, the machine screw 62 may then be operated (in this case turned clockwise) so that its end moves against the top of the unit 60 and forces the saddle 61 away from the unit 60. This action serves to drive the electrical connection spikes through the installation cable 63. As will be apparent to the skilled person, means other than the screw 62 may be provided to perform this same function.

Figures 7a and 7b show a further embodiment of the

present invention which is similar to the embodiment of Figures 6a and 6b with the exception that the saddle is omitted. The cable tie locating notches may instead be formed directly in an upper edge 70 of the unit 71. Means are provided inside the unit 71 (not shown) for moving the tips of the electrical connection spikes in a direction away from the unit 71 so that, in use, the spikes extend further towards the cable 72. These means are operable by, in this example, rotation of a rod head 73 which is located on the top surface of the unit 71. Naturally other means for operating the spike driving means will be apparent to the skilled person and may be used instead.

In use, the unit 71 is placed adjacent the cable 72 and the cable ties 74 are tightened by hand as previously. The rod 73 (which may be made of nylon of, for example a millimetre diameter) is then operated (e.g. turned clockwise) to drive the contact spike(s) out of the base of the coupler into the cable thereby tensioning the cable ties and piercing the cable insulation to make contact with the conductor.

In either of the embodiments of Figure 6 or Figure 7, or indeed in any of the embodiments described previously, the base 68, 78 of the unit 60, 71 may be shaped differently to that shown in the drawings. In a preferred embodiment, the base 68, 78 may be shaped so as to conform more closely to the surface shape of the cable which, in this example, is roughly circular. This enables the unit 60, 71 to be more easily located against the cable.

Each of the embodiments of the present invention described above may be self supporting in that they are supported only by the cable to which they are clamped. A further embodiment of the invention includes having one or more lugs attached to the clamp devices. In this way, the clamps themselves may be attached to a suitable surface.

Furthermore, the embodiments described above are also suitable for coupling communications signals to/from cables with more than one conducting core. In this way, a range of, for example differential, phase to phase,

phase to neutral/earth, phase to earth, neutral to earth or polyphase modes of high frequency signal coupling may be provided.

As will be appreciated, the above embodiments are given by way of example only and modifications will be apparent to those skilled in the art.

Claims

CLAIMS

1. A coupling apparatus suitable for coupling with an electricity cable, where the cable includes an electrically insulated conducting member, where the coupling apparatus includes cable insulation penetration means for penetrating the electricity cable to provide an electrical connection to the conducting member, the penetration means being electrically connected to a coupling member suitable for connection to a telecommunications signal source or receiver.

2. A coupling apparatus according to any one of the above claims including a clamp and a clamp head, wherein the clamp includes the insulation penetration means and means for fitting the insulation penetration means to the cable, and the clamp head includes the coupling member.

3. A coupling apparatus according to claim 1 including low frequency protection means for electrically

isolating the coupling member at low frequencies from the insulation penetration means.

4. A coupling apparatus according to claim 1 or claim 2 including a fuse and/or transformer by which the coupling member may be electrically protected from the cable insulation protection means.

5. A coupling apparatus according to claim 4 in which one end of the primary winding and/or one end of the secondary winding of the transformer is/are electrically bonded to an earth potential.

6. A coupling according to claim 5 in which one end of both the primary and secondary windings of the transformer are electrically bonded to the same earth potential.

7. A coupling apparatus according to any one of the above claims wherein the cable insulation means includes a spike.

8. A coupling apparatus according to any one of the above claims including clamping means for urging the penetration means into the cable.

9. A coupling apparatus according to any one of the above claims including a housing which, in use, fits around the cable.

10. A coupling apparatus according to any one of the above claims wherein the cable insulation penetration means and the coupling member are electrically connected via a conducting spring.

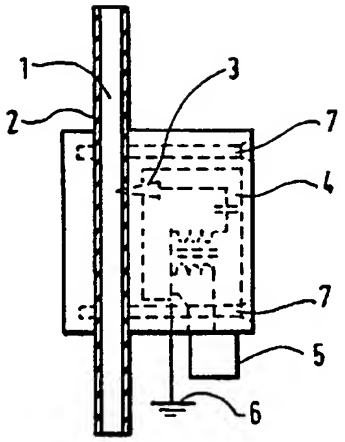

Fig.1.

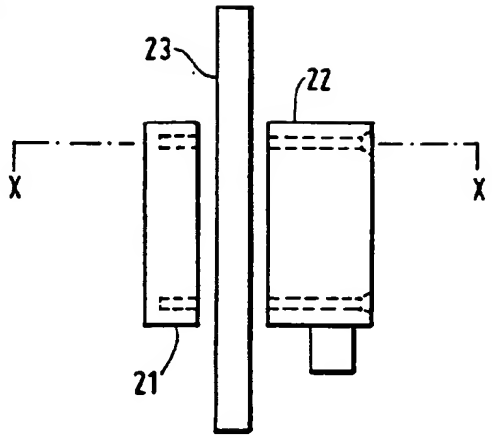

Fig.2.

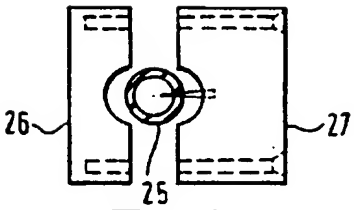

Fig.3.

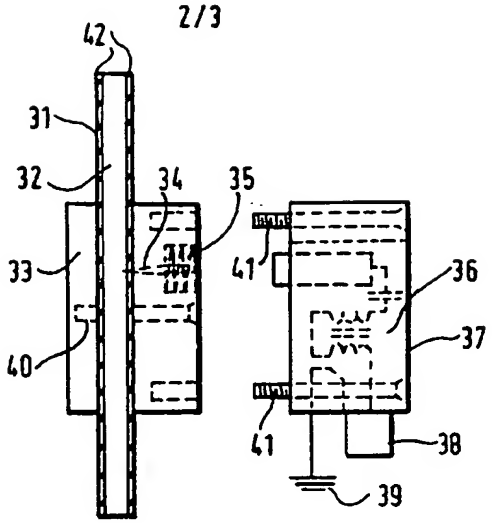

Fig.4.

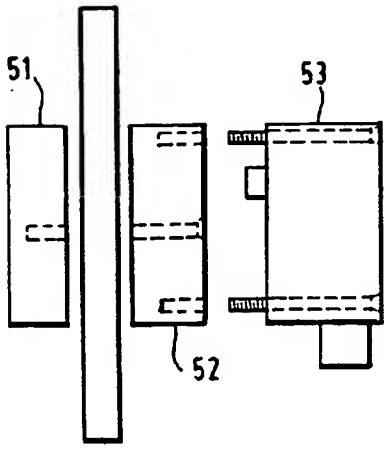

Fig.5.

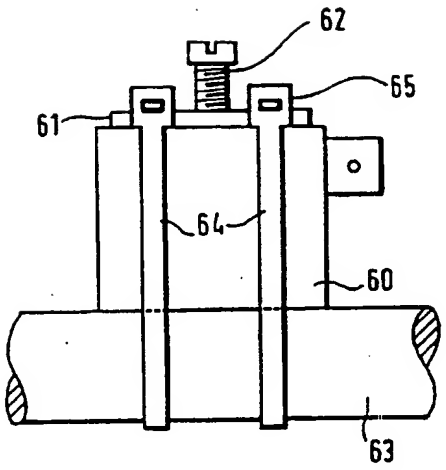

Fig.6a.

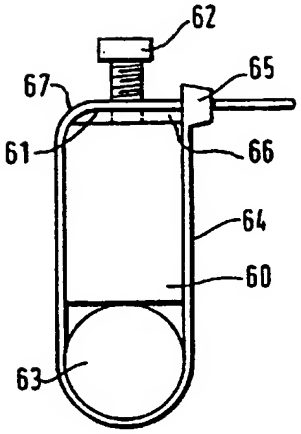

Fig.6b.

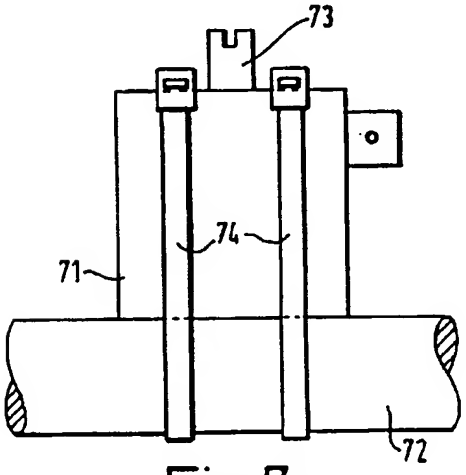

Fig.7a.

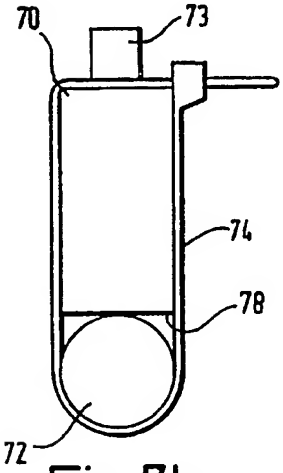

Fig.7b.

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/GB 00/01196

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01R4/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 283 012 A (SUMITOMO ELECTRIC INDUSTRIES) 21 September 1988 (1988-09-21) column 2, line 52 -column 4, line 38; figures 2,4,5	1,2,7-9
X	US 5 367 251 A (MCTIGUE JAMES F) 22 November 1994 (1994-11-22) column 5, line 20-68; figure 3	1,7-9
X	EP 0 471 630 A (GREILLIER BERNARD) 19 February 1992 (1992-02-19) column 3, line 14 -column 4, line 26 figures 2-4	1,8,9
X	WO 98 45896 A (WHITAKER CORP) 15 October 1998 (1998-10-15) claim 1; figures 1,3	1,8,9

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
8 June 2000	19/06/2000

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INTERNATIONAL SEARCH REPORT

Inter nal Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 013, no. 366 (E-806), 15 August 1989 (1989-08-15) & JP 01 122576 A (FURUKAWA ELECTRIC CO LTD:THE), 15 May 1989 (1989-05-15) abstract; figures 1,2	1,7,8
X,P	EP 0 977 309 A (ASCOM SYSTEC AG) 2 February 2000 (2000-02-02) abstract	1,7,8

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter nal Application No
PCT/GB 00/01196

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0283012 A	21-09-1988	JP 1995613 C	08-12-1995
		JP 7021971 B	08-03-1995
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